TAX AND THE USE OF HISTORIC RETURNS IN ESTIMATING THE EQUITY RISK PREMIUM

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DECEMBER 1998

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Abstract

The paper analyses the use of a historic risk premium as a proxy for the current premium allowing current tax rates to differ from historic rates. If tax rates are assumed constant, adjustments to the CAPM for an imputation system make the CAPM and cash flows to be discounted consistent with respect to tax, but do not model any effect of tax on the cost of equity. If tax rates are allowed to vary, and a historic premium is used, the cost of equity is affected by the level of tax at which investors are assumed to set their required premium. This is illustrated by considering the impact on the cost of equity of the change in the UK imputation system in July 1997.

1. Introduction

The starting point in this paper is that a historic risk premium is used to estimate the current risk premium in the capital asset pricing model (CAPM). There are reservations about this approach, but there is no agreed alternative. If there is an imputation system, as in the UK, the classical CAPM requires adjustment, and several authors have put forward revised formulae. The adjustments for an imputation system proposed to date are to make the CAPM and cash flows consistent with respect to tax. They are not a statement about the effect of tax on the cost of equity, because tax rates are assumed constant. This is illustrated in section 2 of the paper by summarising Ashton's adjustments to the classical CAPM. The only tax consideration regarding use of a historic premium is to ensure that the historic return on equity and risk free rate are measured in practice at the same level of tax as is assumed in the adjusted model.

However, tax rates on equity and debt have in fact varied considerably, and if allowance is made for this, the specification of the CAPM depends on a further factor, which is the level of tax at which investors set their required premium. Investors are assumed to set the prices of shares so that, in equilibrium, the return they require for the risk involved is the same as the return they expect. But it is uncertain how the returns they require are measured with respect to tax, and the assumption made about this can affect the size of the required premium, if current tax rates differ from average historic rates. The assumption made also affects the adjustments to the classical CAPM for the imputation system. Section 3 presents expressions for the classical and adjusted CAPM which use average historic returns as measured in the Barclays Capital (formerly BZW) *Equity-Gilt Study* and which assume that investors set their required premium either before all tax, before personal tax or after all tax. The argument is illustrated in section 4 by analysing the impact on the cost of equity of the 1997 change in the UK imputation system. The notion of the level of tax at which required returns are fixed is prominent in King & Fullerton (1984) but their concern was with estimating the effective rate of tax on returns to company investment rather than with the cost of equity.

2. The CAPM and imputation system assuming constant tax rates

The original derivation of the CAPM assumes no taxes. A formal derivation with corporate and personal taxes was first provided by Brennan (1970) in the context of a classical tax system, and his approach has been followed for the UK imputation system by Ashton (1989a, 1989b and 1991). These are single period models in which an investor's utility is positively related to his portfolio's expected return and negatively related to its expected variance, with differing risk aversion across investors. The difference from the original CAPM is that end of period cash flows are received by investors after taxes. Because they are single period models, tax rates are constant. We shall use Ashton's expressions of the CAPM to exemplify the adjustments called for by an imputation system.[1]

The UK imputation system implies both that the tax advantage of debt is smaller than in the USA and that conventional project cash flows expressed before interest and after full corporation tax, including imputed income tax, are approximately after personal tax as well. Ashton derives two adjusted CAPM formulae; one assumes no tax advantage to debt and the other assumes that debt has some tax advantage. If there is no tax advantage to debt,

$$(1 - T_D) = (1 - T_{CF})(1 - T_{EE}) \quad (1)$$

where

T_D = personal tax rate on debt;

T_{CF} = full corporation tax rate, including imputed income tax;

T_{EE} = personal tax rate on equity returns net of imputed income tax on dividends. In practice T_{EE} currently reflects any higher rate tax on dividends and any capital gains tax (CGT).[2]

Ashton assumes that T_{EE} is the same for both dividends and capital gains, which means that dividend policy is irrelevant to the cost of equity as far as tax is concerned. The CAPM expressed after all tax which he derives is:

$$E(R_E)^{A1}(1 - T_{EE}) = R_F(1 - T_D) + \beta[E(R_M)^A(1 - T_{EE}) - R_F(1 - T_D)]. \qquad (2)$$

In this equation, the 'A' superscript in $E(R_E)^{A1}$ and $E(R_M)^A$ signifies that expected returns on equity are expressed after the full corporation tax rate, including imputed income tax, because Ashton treats the return on equity as the net dividend yield plus capital gain before CGT. The '1' superscript in $E(R_E)^{A1}$ is to distinguish between the two versions of the adjusted CAPM. Equation 2 is simply the CAPM with all the returns expressed after all tax. To be applicable to cash flows after corporation tax, the cost of equity must also be expressed after corporation tax. With no tax advantage to debt, equation 1 holds, so dividing through by $(1 - T_{EE})$ gives (Ashton, 1989a, p. 82):

$$E(R_E)^{A1} = R_F(1 - T_{CF}) + \beta[E(R_M)^A - R_F(1 - T_{CF})]. \qquad (3)$$

Alternatively, if $(1 - T_D) > (1 - T_{CF})(1 - T_{EE})$, there is some tax advantage to debt. If the personal tax rates on debt (T_D) and on gross dividends are assumed to equal the basic income tax rate T_M, the CAPM expressed after all tax is:

$$E(R_E)^{A2}(1 - T_M)/(1 - T_I) = R_F(1 - T_M) + \beta[E(R_M)^A(1 - T_M)/(1 - T_I) - R_F(1 - T_M)] \qquad (4)$$

where T_I is the rate of imputed income tax or rate of imputation. In this equation, returns on equity are treated as though they were entirely in the form of dividends. This is because total personal tax rates on dividends and capital gains are assumed equal, and the CGT rate therefore equals $(1 - T_M)/(1 - T_I)$. To be applicable to cash flows after corporation tax, returns on equity must be measured gross of the personal tax rate (T_M) but net of the rate of imputation (T_I), which means multiplying through by $(1 - T_I)/(1 - T_M)$ to give (Ashton, 1991, p. 477):

$$E(R_E)^{A2} = R_F(1 - T_I) + \beta[E(R_M)^A - R_F(1 - T_I)]. \qquad (5)$$

The effect of the adjustments in equations 3 and 5 is to put the returns to equity and debt in the CAPM on the same level with respect to tax, and this can be represented diagrammatically. Figure 1 compares the tax rates on returns to equity and debt assuming that debt has no tax advantage (equation 3). The horizontal dashed lines represent different levels of tax at which rates of return are measured. For example, $R_F(1 - T_{CF})$ is the rate of return on risk free debt measured after subtracting tax at a rate equivalent to the full corporation tax rate. Returns on both equity and debt are after corporation tax, because the cash flows to be discounted are assumed to be net of corporation tax, and the total tax rate on debt is assumed to be the same as the total tax rate on equity. Figure 2 compares the tax rates on returns to equity and debt assuming that debt has a tax advantage (equation 5). The same rate of personal tax (T_M) applies to both, but because the rate of imputation is less than the corporation tax rate, the total tax rate on equity is greater. As in equation 3, returns on equity are after the full corporation tax rate, but returns on debt are after tax only to the extent that the tax advantage to debt is less than the equivalent of the corporation tax rate. On the assumptions made for equation 5, this means that returns on debt are net of the rate of imputation (though it is not the rate of imputation which determines the tax advantage to debt but the difference between the total tax rate on equity and the personal tax rate on debt).

To apply the CAPM using historic returns to estimate the risk premium, we need to consider how such returns are measured. The *Equity-Gilt Study* is widely referred to in the UK; two papers which present risk premium estimates, Allen et al (1987) and Dimson & Brealey (1978), themselves use its data. The study has been published annually since 1956 and reports annual returns on shares, long gilts, Treasury bills and building society accounts

since 1919. The returns on equity are calculated using the FT-Actuaries All Share Index from 1963 and an index constructed by Barclays for 1919-62. Undated gilts are used in estimating annual gilt returns before 1962, and gilts with an average term to maturity of 20 and 15 years are used respectively for 1962-89 and 1990 onwards. Dividends gross of all personal tax, including imputed income tax, are assumed to be reinvested at the end of each year. CGT is ignored and income tax is not subtracted from returns on gilts or Treasury bills.[3]

The arithmetic mean historic annual return on equity and mean historic risk free rate are substituted for the expected return on equity and risk free rate in the risk premium.[4] Equations 3 and 5 specify adjustments for tax to the risk free rate in the premium. To be used in practice, they also call for an adjustment to the historic return on equity as measured; it should be net of imputed income tax on dividends to correspond with the way the expected return is expressed with respect to tax, that is with $E(R_M)^A$. Alternatively, the cash flows to be discounted could be measured before personal tax (after corporation tax but with imputed income tax added in).

In summary, if tax rates are assumed constant, the return on equity and risk free rate in the CAPM are ‘brought into line’ with the level of tax at which cash flows to be discounted are measured. The adjustments to the classical CAPM are not saying anything about the effect of tax on the cost of equity. But if tax rates are allowed to vary, and a historic premium is used as a proxy for the current premium, a view needs to be taken about the level of tax at which investors set their required premium. This is a separate matter from the level of tax at which cash flows are measured.

3. Use of the historic risk premium with varying tax rates

We revert for simplicity to the classical CAPM, returning later to the adjustments presented above. The model expressed before all tax, using the current risk free rate and a historic risk premium, is:

$$E(R_{EB}) = R_F^* + \beta[av(R_{MBt}) - av(R_{Ft})] \tag{6a}$$

where

$E(R_{EB})$ = cost of equity expressed before all tax;

R_F^* = current risk free rate measured before personal tax

R_{MBt} = historic market return measured before all tax for year t;

R_{Ft} = historic risk free rate measured before personal tax for year t;

av = arithmetic mean.

Estimates of the company's beta may vary slightly depending on the level of tax at which returns are measured, but we ignore this for simplicity. The cost of equity expressed before personal tax, $E(R_E)$, is:

$$E(R_E) = R_F^* + \beta[av(R_{Mt}) - av(R_{Ft})] \qquad (6b)$$

where R_{Mt} = historic market return measured before personal tax for year t, which corresponds with how historic returns are measured in practice. This is the standard model. The cost of equity expressed after all tax, $E(R_{EA})$, is:

$$E(R_{EA}) = R_F^*(1 - T_D^*) + \beta[av(R_{MAt}) - av(R_{FAt})] \qquad (6c)$$

where

T_D^* = current personal tax rate on debt;

R_{MAt} = historic market return measured after all tax for year t;

R_{FAt} = historic risk free rate measured after personal tax for year t.

If current tax rates are allowed to differ from the averages of historic rates, the specification of the above equations depends on the level of tax at which investors are assumed to set their required premium. To gain a feel for the effect of this, suppose we have the following returns and tax rates:

Arithmetic mean historic return on equity before personal tax	12% pa
Arithmetic mean historic risk free rate before tax	4% pa
Average historic personal tax rate on equity	25%
Average historic personal tax rate on debt	25%

Current risk free rate before tax	4% pa
Current personal tax rate on equity	50%
Current personal tax rate on debt	25%

Assume a classical tax system, for simplicity. With these figures, the historic risk premium as conventionally measured, after corporation tax and before personal tax, is 8% pa. The premium measured after personal tax is 6% pa. Investors are assumed to require the same premium as they received in the past. If they set their required premium before personal tax, the cost of equity, assuming a beta of one, is 12% pa before personal tax (4% + 8%). But the cost of equity is only 6% pa expressed after the new personal tax rate of 50%, and the risk premium after personal tax is 3% pa. Alternatively, if investors set their required premium after personal tax, the cost of equity is 9% pa after personal tax (3% + 6%) and 18% pa expressed before personal tax at the new rate.

Table 1 provides expressions for the cost of equity to allow for a situation in which current tax rates may differ from average historic tax rates. Inflation is assumed constant for simplicity.[5] The *observed* average historic return on equity and risk free rate are as measured in the *Equity-Gilt Study*. The current risk free rate is allowed to differ from the average historic risk free rate which appears in the risk premium, and no assumptions are made about the effect of tax on the current risk free rate. The key to understanding the expressions is the level of tax at which the risk premium is fixed. Table 1 shows the cost of equity assuming investors set their premium before all tax, before personal tax, and after all tax. In each of the three cases, the cost of equity can be expressed before all tax, before personal tax, and after all tax. The rule employed is that, for a given level of tax at which the premium is assumed to be fixed, the average historic return and risk free rate measured at that level of tax determine the value of the premium, so that allowance for current tax rates leaves the required premium unaltered at that level of tax. Thus, if the premium is fixed before personal tax, the current personal tax rates on equity and debt affect the premium in the cost of equity expressed after all tax, but not in the cost of equity expressed before personal tax. Alternatively, if the premium is fixed after all tax, the current personal tax rates affect the premium in the cost of equity expressed before personal tax, but not after.

Table 1: Expressions for the cost of equity allowing current tax rates to differ from

average historic tax rates

Definitions

For past year t

Return on market before personal tax	R_{Mt}
Return on ten year gilts before personal tax	R_{Ft}
Effective mainstream corporation tax rate, excluding imputed income tax	T_{CMt}
Effective personal tax rate on equity, including imputed income tax	T_{Et}
Effective personal tax rate on debt	T_{Dt}
Current	
Mainstream corporation tax rate, excluding imputed income tax	$T_{CM}*$
Personal tax rate on equity, including imputed income tax	T_E*
Personal tax rate on debt	T_D*
Gross redemption yield on ten year gilts	R_F*

Returns are nominal. Assume constant inflation.

I. Investors require premium fixed before all tax

Historic return on equity before tax $= R_{MB} = av[R_{Mt}/(1 - T_{CMt})]$

Historic return on gilts before tax $= R_F = av(R_{Ft})$

$\therefore$ Historic risk premium before tax $= R_{MB} - R_F$

Cost of equity expressed:

a. Before all tax $R_F* + \beta(R_{MB} - R_F)$

b. Before personal tax $R_F* + \beta[R_{MB}(1 - T_{CM}*) - R_F]$

c. After all tax $R_F*(1 - T_D*) + \beta[R_{MB}(1 - T_{CM}*)(1 - T_E*) - R_F(1 - T_D*)]$

II. Investors require premium fixed before personal tax

Historic return on equity before personal tax = R_M = $av(R_{Mt})$

Historic return on gilts before personal tax = R_F = $av(R_{Ft})$

$\therefore$ Historic risk premium before personal tax = $R_M - R_F$

Cost of equity expressed:

a. Before all tax $R_F^* + \beta\{[R_M/(1 - T_{CM}^*)] - R_F\}$

b. Before personal tax $R_F^* + \beta(R_M - R_F)$

c. After all tax $R_F^*(1 - T_D^*) + \beta[R_M(1 - T_E^*) - R_F(1 - T_D^*)]$

III. Investors require premium fixed after all tax

Historic return on equity after all tax = R_{MA} = $av[R_{Mt}(1 - T_{Et})]$

Historic return on gilts after all tax = R_{FA} = $av[R_{Ft}(1 - T_{Dt})]$

$\therefore$ Historic risk premium after all tax = $R_{MA} - R_{FA}$

Cost of equity expressed:

a. Before all tax $R_F^* + \beta\{[R_{MA}/(1 - T_E^*)(1 - T_{CM}^*)] - R_{FA}/(1 - T_D^*)\}$

b. Before personal tax $R_F^* + \beta\{[R_{MA}/(1 - T_E^*)] - R_{FA}/(1 - T_D^*)\}$

c. After all tax $R_F^*(1 - T_D^*) + \beta(R_{MA} - R_{FA})$

Historic returns on the market are measured before imputed income tax, but are net of corporation tax paid which is not also imputed income tax. In post-1973 terminology, returns are before advance corporation tax (ACT) but net of mainstream corporation tax (MCT). When there is no imputation system, all corporation tax counts as mainstream. More accurately, returns as measured are net of *effective* MCT; 'effective' is used in the sense of the amount of a tax actually paid divided by the amount of the return before subtraction of this tax payment. The effective corporation tax rate, and therefore effective MCT rate, for each year will be lower than the statutory rate because of tax concessions. That is, the amount of corporation tax paid divided by the amount of reported profits will be less than notional corporation tax payments levied at the statutory rate, divided by reported profits. The effective personal tax rate on equity depends on the tax rates paid by different categories of investor, and the proportion of quoted shares owned by each category. When there is an imputation system, the effective MCT rate and personal tax rate on equity also depend on the dividend payout policies of companies represented in the index used to estimate market returns.

The reason for needing effective rather than statutory rates is application of the principle of using the actual premium obtained in the past as a proxy for the premium investors require in the future. The estimate of the actual premium obtained depends on the estimated amount of tax actually paid on returns to equity and government debt at each level of measurement (for example, estimated tax paid is zero for returns measured before all tax). However, estimates of historic effective MCT and personal tax rates on the market and personal tax rates on government debt are not readily available.[6] They are not needed if returns are assumed to be fixed before personal tax, because returns are measured before personal tax in the *Equity-Gilt Study*. But lack of historic effective tax rates is an obstacle to implementing equations Ia-c and IIIa-c in Table 1, which assume that returns are fixed before all tax and after all tax respectively. Whether the *current* tax rates used are statutory rates or estimates of effective rates depends on whether the cash flows to be discounted are measured after statutory or effective rates.

The equations in Table 1 are based on the classical CAPM. The reasoning explained can be used to derive applied versions of equations 3 and 5, which specify adjusted premiums of the form $E(R_M)^A$ - $R_F(1 - T_{CF})$ and $E(R_M)^A$ - $R_F(1 - T_I)$ respectively. Suppose first that investors set their required premium before personal tax, ie they require R_M - R_F, the historic premium as measured in the *Equity-Gilt Study*. R_M is measured before imputed income tax on dividends, while $E(R_M)^A$ is expressed after imputed tax. In this case the proxy for $E(R_M)^A$ is $R_M(1 - T_{IE}*)$, where $T_{IE}*$ is the current rate of imputation times the market's current dividend payout ratio. $R_M(1 - T_{IE}*)$ is the historic return on equity measured before personal tax, net of estimated imputed income tax given the current rate of imputation and current dividend policy. The proxy for $R_F(1 - T_{CF})$ in equation 3 is $R_F(1 - T_{CF}*)$, where $T_{CF}*$ is the current full corporation tax rate. Equation 3 using historic R_M - R_F is:

$$E(R_E)^{A1i} = R_F*(1 - T_{CF}*) + \beta[R_M(1 - T_{IE}*) - R_F(1 - T_{CF}*)]. \tag{7a}$$

It may be helpful to reiterate the reasoning. The premium investors require is assumed to be R_M - R_F but equation 3 specifies a premium of $E(R_M)^A$ - $R_F(1 - T_{CF})$. As explained in section 2, this specification puts the returns on equity and the risk free rate on the same level with respect to tax, so that the cost of equity as specified can be used to discount cash flows after full corporation tax. To apply equation 3, R_M and R_F are adjusted by the appropriate current tax rates; the premium expressed before these adjustments is R_M - R_F, which is what investors are assumed to require. Equation 5 using historic R_M - R_F is:

$$E(R_E)^{A2i} = R_F*(1 - T_I*) + \beta[R_M(1 - T_{IE}*) - R_F(1 - T_I*)] \tag{7b}$$

where T_I* is the current rate of imputation.

Now suppose that investors require the historic premium measured after all tax, vis R_{MA} - R_{FA}. The proxy for $E(R_M)^A$ on this assumption is $R_{MA}/(1 - T_{EE}*)$, the historic return after all tax grossed up by the current tax rate on the market in excess of imputed income tax. The proxy for $R_F(1 - T_{CF})$ is $R_{FA}(1 - T_{CF}*)/(1 - T_D*)$, the historic risk free rate measured after all tax grossed up by the personal tax rate on debt to give a before current tax measure, which is then multiplied by $(1 - T_{CF}*)$. So equation 3 using historic R_{MA} - R_{FA} is:

$$E(R_E)^{A1ii} = R_F^*(1 - T_{CF}^*) + \beta[R_{MA}/(1 - T_{EE}^*) - R_{FA}(1 - T_{CF}^*)/(1 - T_D^*)] \quad (8a)$$

and equation 5 is:

$$E(R_E)^{A2ii} = R_F^*(1 - T_I^*) + \beta[R_{MA}/(1 - T_{EE}^*) - R_{FA}(1 - T_I^*)/(1 - T_D^*)] \quad (8b)$$

If $T_{EE}^* \approx 0$, ie higher rate tax on dividends and CGT are assumed to be negligible (see note 2), $T_{IE}^* \approx$ the current personal tax rate on equity in Table 1, T_E^*. If, in addition, the current rate of imputation and tax rate on debt are approximately equal (the statutory rate for both is 20%), $T_I^* \approx T_D^*$. Given these approximations, equations 7b and 8b are currently the same as the expressions for the classical CAPM given by equations IIc and IIIc respectively in Table 1, which are after all tax.

4. An illustration: the change to the imputation system in July 1997

The above analysis raises the obvious question of which of the three levels of tax is it most plausible that investors set their required premium. A full discussion of this is not attempted here, but the most likely possibilities are that the premium is fixed before personal tax or after all tax. King & Fullerton (1984, pp. 11-12) argue that companies can be expected to allocate capital between projects so that they produce the same expected return after corporation tax (ignoring differences in risk), which means that relatively highly taxed projects have a relatively high cost of capital expressed before all tax. They argue that restrictions on movement of funds between different categories of investor mean that the return after personal tax varies with investor category. For example, the after personal tax return is higher for a pension fund than for a taxpaying individual, and there are limits to how much an individual can save via a pension fund.

If this is accepted, it still does not necessarily mean that the required premium is fixed before personal tax, ie that changes in personal tax rates have no effect on the cost of equity expressed before personal tax. Miller's (1977) equilibrium depends on the existence of categories of investor with differing personal tax rates, and implies that the before personal tax cost of equity and debt is affected by personal tax rates. The reason why there is no tax advantage to debt in his model is that, to attract lenders, companies are assumed to increase (gross) rates of interest to the point at which the total tax burden on debt and equity is equal for marginal investors. Higher rates of interest entice investors who pay higher personal tax rates on interest to buy debt. This line of reasoning implies that, say, an increase in personal tax rates on equity would make the total tax burden on equity greater than on debt for some investors, who would therefore switch from equity to debt (or some other asset). This tax-motivated selling of shares would imply a rise in the cost of equity *before personal tax*, to the extent that required returns after all tax fall by less than the increase in the personal tax rate. The empirical evidence is mixed on whether personal tax rates affect the cost of equity expressed before personal tax.

The practical relevance of whether the required premium is fixed before or after personal tax may be illustrated by considering how one might go about measuring the impact of the most recent change in the tax regime on the cost of equity. From July 1997, pension funds and charities could no longer reclaim ACT. Since these investors own one third of quoted company shares and the ACT rate is 20%, this means that the effective personal tax rate on dividends rose by nearly seven percentage points. Nearly two-thirds of the return on shares has come in the form of dividends (*Equity-Gilt Study*, 1998, p. 6), so the average effective personal tax rate on equity has risen by approximately 4.5 percentage points. Table 2 compares the effect of this increase on the risk premium assuming that investors set their required premium before personal tax with the effect assuming the premium is fixed after all tax.

Table 2: Illustration of the impact of the change in the imputation system in July 1997 on the risk premium

Assumptions

Arithmetic mean historic annual return 1919-97

on equity before personal tax as measured: R_M	=	15% pa (actual)
on equity after effective personal tax: R_{MA}	=	10% pa (hypothetical)
on ten year gilts before personal tax: R_F	=	7% pa (actual)
on ten year gilts after effective personal tax: R_{FA}	=	5% pa (hypothetical)
Current effective personal tax rate		
on equity before July 1997: T_E*	=	10% (hypothetical)
on equity after July 1997: T_E*	=	14.5% (hypothetical, but increase approximately correct)
on debt before and after July 1997: T_D*	=	20% (hypothetical)

I. Investors require premium fixed before personal tax

Risk premium	**Before July 1997**	**After July 1997**
Expressed before personal tax:		
$(R_M - R_F)$	= 8.00% pa	= 8.00% pa
after all tax:		
$[R_M(1 - T_E^*) - R_F(1 - T_D^*)]$	= 7.90% pa	= 7.23% pa

II. Investors require premium fixed after all tax

Risk premium	**Before July 1997**	**After July 1997**
Expressed before personal tax:		
$\{[R_{MA}/(1 - T_E^*)] - R_{FA}/(1 - T_D^*)\}$	= 4.86% pa	= 5.45% pa
after all tax:		
$(R_{MA} - R_{FA})$	= 5.00% pa	= 5.00% pa

Apart from the historic returns on the market and on long gilts, the numbers used are hypothetical but intended to be plausible. The point of the example is to show how both the size of the risk premium and the effect of an actual change in the tax regime on the cost of equity are sensitive to the level of tax at which the premium is assumed to be fixed. Before the 1960s, most shares were owned by individuals rather than by tax-privileged institutions, and the ability of pension funds to reclaim ACT was only introduced in 1973. So effective personal tax rates on equity are taken as having been considerably higher on average in the past 79 years than was the effective rate just before July 1997. A consequence of this is that the premium expressed before personal tax which results if it is also set before personal tax - the conventional 8% - is much larger than if the premium is set after personal tax.

A further point is that the increase in personal tax on equity has no effect on project value with the required premium assumed to be fixed before personal tax, assuming that the current risk free rate is unaffected. If cash flows before personal tax (including imputed income tax) are discounted, the cost of equity remains unchanged. If cash flows after all tax are discounted, the amount of tax deducted is higher but the discount rate is lower. But with the required premium fixed after personal tax, the increase in personal tax on equity reduces project value. Cash flows before personal tax are unchanged, but the discount rate is higher. Cash flows after all tax are lower and are discounted at an unchanged rate.

5. Concluding remark

At present the lack of a series of historic returns on equity and gilts after effective personal tax precludes estimation of the cost of equity with the required premium assumed to be fixed after all tax. It would seem worth attempting to produce such a series; the estimates in King (1977) of the effective personal tax rates on equity for the years 1947-71 are a starting point. As section 4 illustrates, it is possible that the premium will differ considerably depending on whether investors set their required premium before personal tax, as is conventionally assumed, or after all tax.

Acknowledgements: I am grateful to Andy Adams and Andrew McCosh for their comments on an earlier version of this paper.

Notes

1. There have been other adjustments proposed, but our purpose is not to review all the possibilities. Monkhouse (1993) applies a similar analysis to that of Brennan and Ashton to the Australian imputation system. He differs from Ashton because dividend policy is not assumed irrelevant, and the rate of imputed income tax is the same as the corporation tax rate. Dempsey (1996) analyses the cost of equity in terms of the dividend discount model, but he also presents a CAPM which is the same as equation 5 in the text, if dividend policy is assumed irrelevant (pp. 1324-5). Dimson & Marsh (1982) and Buckley (1995) recommend a simplified approach in which the unadjusted CAPM is multiplied by one minus the basic rate of income tax.

2. Both are small. Only individuals may be liable for higher rate tax on dividends. They own directly less than one fifth of listed shares, not all are higher rate tax payers, and those who are can avoid some tax through personal equity plans. Receipts from CGT were £1.3bn in the 1997-98 tax year, of which 70% related to financial assets. This compares with £30.1bn from corporation tax, including £11.8bn from advance corporation tax (*Inland Revenue Statistics 1997-98*).

3. London Business School's *Risk Measurement Service* also measures returns with gross dividends reinvested, and the US counterpart of the *Equity-Gilt Study*, the *Stocks, Bonds, Bills and Inflation Yearbook* by Ibbotson Associates, measures returns before personal tax.

4. Some authors advocate using geometric means, but this debate is beyond our scope.

5. Investors are usually assumed to be interested in real returns, in which case it is the relationship between taxes and real returns which affects the cost of equity. Most taxes apply to nominal returns (a current exception is CGT). For a given tax rate on nominal returns, the resulting tax rate on real returns is higher if there is inflation, and is positively related to the rate of inflation. Expressions for the real cost of equity can be given which result from the reasoning to be explained and which allow both tax rates and inflation to vary over time. Investors are assumed to require a *real* premium fixed, as in Table 1, either before tax, before

personal tax or after all tax. The expressions are more complicated than those in Table 1, and since the reasoning underpinning them is the same, they are not presented. The current inflation rate is similar to the average rate of 4.1% pa during 1919-97, so the estimates will not differ much from those given by converting the equations in Table 1 to real terms at the current inflation rate.

6. The *Equity-Gilt Study* provides real returns on equities from 1919 with dividends reinvested net of maximum rate income tax and real returns from 1961 with dividends reinvested net of basic rate income tax. King (1977) provides estimates of the effective personal tax rates on dividends and capital gains for the years 1947-71. They are weighted averages of the tax rates across categories of investor for each year, with each rate weighted by an estimate of the proportion of shares owned by the appropriate category of investor in the appropriate year. Individuals are apportioned into several categories according to their income tax bracket and assumed to pay the highest rate of tax applicable to their bracket.

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